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ORIGINAL ARTICLE

Embolisation of Perimembranous Ventricular Septal Defect Occluder and Transcatheter Retrieval

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Aims In this study, we aim to summarise our experience with techniques used for the transcatheter retrieval of embolised devices.

Methods We retrospectively reviewed the transcatheter retrieval of embolised devices in seven patients who underwent an attempted transcatheter closure of perimembranous ventricular septal defects (PMVSDs) between October 2002 and October 2013. The incidence, the main causes for the device's embolisation, and the techniques for transcatheter retrieval of the embolised device are discussed.

Results The incidence of device embolisation in our centre was 0.82% (seven embolisations in 852 device placements). The main causes for device embolisation included undersized devices and inadequate subaortic rims. Among the seven embolisations, six of the devices were retrieved percutaneously without mortality, while one was retrieved during surgery. Of these patients, five had a HeartR^{TM} Membranous VSD occluder of their PMVSDs, and the remaining two had surgical PMVSD closures.

Conclusions Our approach to the transcatheter retrieval of the embolised devices is associated with good results.

Keywords Transcatheter • Perimembranous Ventricular septal defects • Snare • Incidence • Device

Introduction

Ventricular septal defects (VSDs) account for 20% of all forms of congenital heart diseases. Perimembranous VSD (PMVSD) is the most common subtype, accounting for 80% of all VSDs, followed by the muscular type, which accounts for 5% to 20% of all defects [1]. Due to the special anatomic position of PMVSD and equipment limitations, the widespread usage of transcatheter closures of PMVSDs is controversial. With the use of domestic HeartR^{TM} Membranous VSD occluders (Lifetech Scientific Co., Ltd., Shenzhen, P. R. China), transcatheter closures of PMVSDs have been widely performed in China over the past 10 years. However, the embolisation of occluders is potentially catastrophic; it is of paramount importance that we are prepared with the techniques and equipment required for percutaneous retrieval. To date, reports on the techniques of transcatheter retrieval are rare. Thus, this study aims to discuss the incidence and main causes for device embolisation, as well as transcatheter retrieval techniques.

Materials and Methods

Patients

From October 2002 to October 2013, a total of seven patients with PMVSD experienced device embolisation during

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transcatheter closure of their PMVSD. The following data were collected for each embolised device: patient age, patient weight, defect size, Qp/Qs, type of device used, device size, location to which the device embolised, perceived cause of embolisation, sheath size used, technique used to retrieve embolised device, and the ultimate method of PMVSD closure (surgery or transcatheter). Approval for this retrospective study was obtained from the Medical Ethics Committee of The Second Xiangya Hospital of Central South University.

Device

The HeartR^{TM} Membranous VSD Occluder (Lifetech Scientific Co., Ltd., Shenzhen, P. R. China) is self-expandable and made of Nitinol wire. The devices included a symmetric, asymmetric, and symmetric with larger left disc Membranous VSD Occluder (Fig. 1A-C). The specialised delivery system ranged from 5Fr to 12Fr.

Closure Protocol

PMVSD closure was performed under local anaesthesia or under general anaesthesia in young children. The procedure of the transcatheter closure of PMVSD was carried out as described previously [2–8]. An electrocardiogram monitor was used throughout the procedure, and TTE guidance was utilised. Heparin (100 units/kg) and an antibiotic were administered to all patients prior to the procedure. All patients underwent a standard right and left cardiac catheterisation through the percutaneous transfemoral route. Angiography in the left ventricle at a 60°/20° left anterior oblique projection/cranial was used to profile the PMVSD. The location and size of the PMVSD, as well as its relationship with the aortic valve, were assessed. Each PMVSD was categorised by shape as tubular, window-like, aneurysmal, or infundibular. The diameter of the PMVSD was measured at the largest diastolic phase, and a device size of 1 to 2 mm larger than the diameter of the defect as assessed by angiography was selected. The defect was then passed from the left ventricle by a 5Fr partly cut pigtail catheter or a right Judkins catheter. An arteriovenous circuit was set up using a femoral vein approach on the same side. A long sheath was advanced to the left ventricle through the arteriovenous circuit and positioned beneath the aortic valve. Through the long sheath, the HeartR^{TM} Membranous VSD occluder was deployed under fluoroscopic control and echocardiographic guidance. Angiography in the left ventricle and ascending aorta was performed again to verify complete occlusion and to identify any new-onset aortic valve regurgitation. After the intervention, patients were transferred to the general wards. Continuous ECG monitoring was used during the first 24 hours after the procedure. Aspirin (5 mg/kg daily) was administered for six months in all patients. Chest radiography, an ECG, and a TTE were obtained before discharge and were further scheduled after one to three months and then six months thereafter.

Transcatheter Retrieval Techniques

Should an embolised device fall into pulmonary circulation, percutaneous device retrievals may be performed, step-by-step, using two long sheaths (SteerEase^{TM} delivery system, Lifetech Scientific Co., Ltd., Shenzhen, P. R. China) and gooseneck snares (Amplatz Goose Neck Snare Kit, ev3 Inc., Phymouth, MN, USA). First, a gooseneck snare through the delivery sheath should be used to grab the waist of the device and to pull it into the inferior vena cava. Second, a contralateral femoral vein puncture should be performed and a larger retrieval sheath should be advanced into the inferior vena cave through the contralateral femoral vein. Most importantly, the embolised device should be stabilised

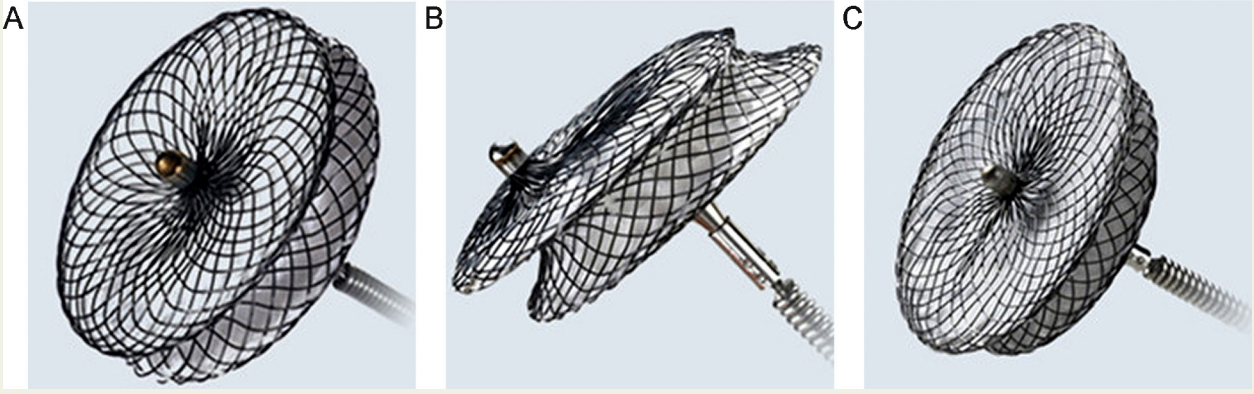

Figure 1 (A) Lateral view of the HeartR^{TM} symmetrical perimembranous ventricular septal defect occluder. The diameter of both discs is 4 mm larger than that of the waist. The thickness of the waist of the HeartR^{TM} membranous VSD-Occluder is 3.5 mm. (B) Lateral view of the HeartR^{TM} asymmetric membranous ventricular septal defect occluder. The diameter of both discs is 6 mm larger than that of the waist. The thickness of the waist of HeartR^{TM} membranous VSD-Occluder is 4 mm. (C) Lateral view of the HeartR^{TM} symmetric with larger left disc membranous ventricular septal defect occluder. The diameter of the left disc is 7.6 mm larger than that of the waist; the diameter of the right disc is 5 mm larger than that of the waist. The thickness of the waist on the HeartR^{TM} membranousVSD-Occluder is 3.5 mm.